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(71) Applicant: **HUAWEI TECHNOLOGIES CO., LTD.** [CN/CN]; Huawei Administration Building Bantian, Longgang District, Shenzhen, Guangdong 518129 (CN).

(72) Inventor; and

(71) Applicant *(for MN only)*: **XIA, Baiqiang** [CN/SE]; Huawei Technologies Sweden AB, Skalholtsgatan 9, 16440 Kista (SE).

(72) Inventor: **SUN, Shiyan**; Huawei Technologies Sweden AB, Skalholtsgatan 9, 16440 Kista (SE).

(74) Agent: **HUAWEI EUROPEAN IPR**; Huawei Technologies Duesseldorf GmbH, Riesstr. 25, 80992 Munich (DE).

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(54) **Title:** DEVICES, METHODS AND COMPUTER PROGRAMS FOR AUTOMATIC EXPANSION STATE CONTROL OF A FLEXIBLE DISPLAY

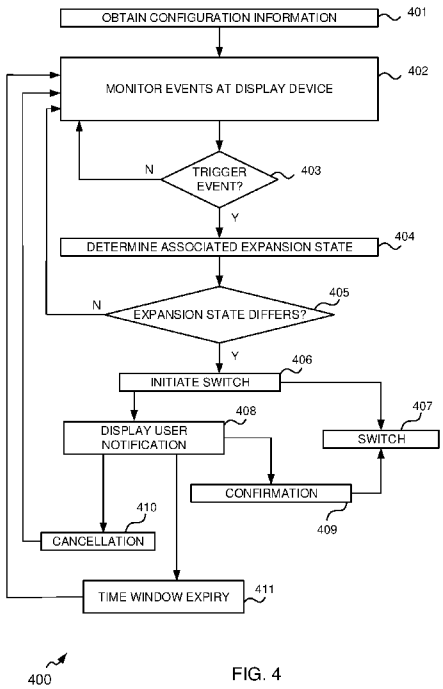

FIG. 4

(57) **Abstract:** Devices, methods and computer programs for automatic expansion state control of a flexible display are disclosed. The invention allows automatic expansion state control of a flexible dis-play of a display device in accordance with trigger events, such as user operations or contents being displayed, thereby saving user effort and enhacing user experience by making explicit user instructions and interactions for controlling the expansion states unnecessary.

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DEVICES, METHODS AND COMPUTER PROGRAMS FOR AUTOMATIC EXPANSION STATE CONTROL OF A FLEXIBLE DISPLAY

TECHNICAL FIELD

The present disclosure relates to the field of automation, and, more particularly, to automatic expansion state control of a flexible display, and related devices, methods and computer programs.

BACKGROUND

In recent years, interest towards flexible display technologies has been growing among consumer electronics manufacturers. In comparison with a traditional flat screen display, a flexible display is flexible in nature, and can be curved and used in many devices. The flexible displays are typically made of plastics materials, which can be more durable with time, lighter in weight, and thinner in shape, in comparison with flat screen displays which are typically made of glass.

So far, the development of flexible screen devices has concentrated on the hardware design, e.g., how to physically design a flexible display into a mobile device where the available space is limited and narrow, or how to realize expansion and contraction of a flexible display with a motor.

There has been much less attention given to the way users can interact with a flexible display. For example, to expand or contract a flexible display, current implementations may require explicit user instructions, such as finger touches, slides or presses to expand or contract a flexible display.

Yet, at least in some situations, there may be a need for implementing automatic expansion state control of a flexible display so that a flexible display may be expanded and/or contracted without explicit user instructions.

SUMMARY

This summary is provided to introduce a selection of concepts in a simplified form that are further described below in the detailed description. This summary is not intended to identify

key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter.

It is an object of the invention to allow automatic expansion state control of a flexible display. The foregoing and other objects are achieved by the features of the independent claims. Further implementation forms are apparent from the dependent claims, the description and the figures.

According to a first aspect, a display device is provided. The display device comprises a flexible display that is programmably switchable between expansion states including at least two of: a contracted state, one or more partially expanded states, or a fully expanded state. The display device is configured to monitor events at the display device. In response to detecting a trigger event among the monitored events, the display device is further configured to determine an expansion state associated with the detected trigger event. In response to the determined expansion state differing from a current expansion state, the display device is further configured to initiate a switch of the flexible display from the current expansion state to the determined expansion state. The present disclosure allows automatic expansion state control of the flexible display of the display device, e.g., in accordance with predetermined trigger events, thereby saving user effort and enhacing user experience by making explicit user instructions and interactions for controlling the expansion states unnecessary.

In an implementation form of the first aspect, the display device is further configured to cause the flexible display to switch from the current expansion state to the determined expansion state in response to the initiation of the switch. This implementation form allows immediate proceeding to the switching of the expansion state.

In an implementation form of the first aspect, the display device is further configured to display a user notification on the flexible display in response to the initiation of the switch. The displayed user notification requests confirmation or cancellation of the switch from the current expansion state to the determined expansion state. This implementation form allows the automatic expansion state control of the flexible display to be controllable by a user while using the display device by giving the user a chance to confirm or cancel the automation before the automation takes place.

In an implementation form of the first aspect, the display device is further configured to cause the flexible display to switch from the current expansion state to the determined expansion state in response to obtaining the requested confirmation. This implementation form allows the automatic expansion state control of the flexible display to be controllable by a user while using the display device by giving the user a chance to confirm the automation before the automation takes place.

In an implementation form of the first aspect, the display device is further configured to return to the monitoring of the events at the display device without causing the flexible display to switch from the current expansion state to the determined expansion state in response to obtaining the requested cancellation. This implementation form allows the automatic expansion state control of the flexible display to be controllable by a user while using the display device by giving the user a chance to cancel the automation before the automation takes place.

In an implementation form of the first aspect, the display device is further configured to return to the monitoring of the events at the display device without causing the flexible display to switch from the current expansion state to the determined expansion state in response to failing to obtain either of the requested confirmation or cancellation before a predetermined time window expires. This implementation form allows the automatic expansion state control of the flexible display to be controllable by a user while using the display device by giving the user a chance to confirm or cancel the automation within a time window before the automation takes place.

In an implementation form of the first aspect, the trigger event comprises at least one of: performing a predetermined operation in a predetermined software application at the display device, displaying predetermined content on the flexible display, or a predetermined status of the display device. This implementation form allows automatic expansion state control of the flexible display of the display device in consideration of operations of users when using a software application, contents being displayed on the flexible display, and/or the display device status.

In an implementation form of the first aspect, the display device is further configured to obtain configuration information indicating at least one of: a degree of expansion of the flexible display in at least one of the one or more partially expanded states, at least one software

application to be monitored for the trigger events, at least one operation of the at least one software application to be monitored for the trigger events, displayable content to be monitored for the trigger events, at least one status of the display device to be monitored for the trigger events, at least one display location on the flexible display in at least one of the expansion states, or at least one display mode on the flexible display in at least one of the expansion states. This implementation form allows the user to configure the behavior of the automatic expansion state control of the flexible display of the display device.

In an implementation form of the first aspect, the flexible display comprises a rollable display, a foldable display, or a bendable display. This implementation form allows the automatic expansion state control of the flexible display of the display device with various types of flexible displays.

In an implementation form of the first aspect, the display device comprises a portable computer device, a television device, a vehicle dashboard screen device, or a wearable computer device. This implementation form allows This implementation form allows the automatic expansion state control of the flexible display of the display device with various types of display devices.

According to a second aspect, a display method for a display device is provided. The display device comprises a flexible display that is programmably switchable between expansion states including at least two of: a contracted state, one or more partially expanded states, or a fully expanded state. The display method comprises monitoring, by the display device, events at the display device. In response to detecting, by the display device, a trigger event among the monitored events, the display method further comprises determining, by the display device, an expansion state associated with the detected trigger event. In response to the determined expansion state differing from a current expansion state, the display method further comprises initiating, by the display device, a switch of the flexible display from the current expansion state to the determined expansion state. The present disclosure allows automatic expansion state control of the flexible display of the display device, e.g., in accordance with predetermined trigger events, thereby saving user effort and enhacing user experience by making explicit user instructions and interactions for controlling the expansion states unnecessary.

In an implementation form of the second aspect, the method further comprises causing, by the display device, the flexible display to switch from the current expansion state to the determined

expansion state in response to the initiation of the switch. This implementation form allows immediate proceeding to the switching of the expansion state.

the method further comprises displaying, by the display device, a user notification on the flexible display in response to the initiation of the switch. The displayed user notification requests confirmation or cancellation of the switch from the current expansion state to the determined expansion state. This implementation form allows the automatic expansion state control of the flexible display to be controllable by a user while using the display device by giving the user a chance to confirm or cancel the automation before the automation takes place.

In an implementation form of the second aspect, the method further comprises:
a) causing, by the display device, the flexible display to switch from the current expansion state to the determined expansion state in response to obtaining the requested confirmation;
b) returning, by the display device, to the monitoring of the events at the display device without causing the flexible display to switch from the current expansion state to the determined expansion state in response to obtaining the requested cancellation; and
c) returning, by the display device, to the monitoring of the events at the display device without causing the flexible display to switch from the current expansion state to the determined expansion state in response to failing to obtain either of the requested confirmation or cancellation before a predetermined time window expires. This implementation form allows the automatic expansion state control of the flexible display to be controllable by a user while using the display device by giving the user a chance to confirm or cancel the automation within a time window before the automation takes place.

In an implementation form of the second aspect, the trigger event comprises at least one of: performing a predetermined operation in a predetermined software application at the display device, displaying predetermined content on the flexible display, or a predetermined status of the display device. This implementation form allows automatic expansion state control of the flexible display of the display device in consideration of operations of users when using a software application, contents being displayed on the flexible display, and/or the display device status.

In an implementation form of the second aspect, the method further comprises obtaining configuration information indicating at least one of: a degree of expansion of the flexible

display in at least one of the one or more partially expanded states, at least one software application to be monitored for the trigger events, at least one operation of the at least one software application to be monitored for the trigger events, displayable content to be monitored for the trigger events, at least one status of the display device to be monitored for the trigger events, at least one display location on the flexible display in at least one of the expansion states, or at least one display mode on the flexible display in at least one of the expansion states. This implementation form allows the user to configure the behavior of the automatic expansion state control of the flexible display of the display device.

In an implementation form of the second aspect, the flexible display comprises a rollable display, a foldable display, or a bendable display. This implementation form allows the automatic expansion state control of the flexible display of the display device with various types of flexible displays.

In an implementation form of the second aspect, the display device comprises a portable computer device, a television device, a vehicle dashboard screen device, or a wearable computer device. This implementation form allows This implementation form allows the automatic expansion state control of the flexible display of the display device with various types of display devices.

According to a third aspect, a computer program product is provided. The computer program product comprises program code configured to perform a display method according to the second aspect, when the program code is executed on a computer. The present disclosure allows automatic expansion state control of the flexible display of the display device, e.g., in accordance with predetermined trigger events, thereby saving user effort and enhacing user experience by making explicit user instructions and interactions for controlling the expansion states unnecessary.

Many of the attendant features will be more readily appreciated as they become better understood by reference to the following detailed description considered in connection with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

In the following, example embodiments are described in more detail with reference to the attached figures and drawings, in which:

Fig. 1 includes diagrams illustrating examples of various expansion states of a flexible display;

Fig. 2 is a block diagram illustrating a display device;

Figs. 3A and 3B are diagrams illustrating examples of displaying content on the flexible display in various expansion states;

Fig. 3C is a diagram illustrating examples of a user interface for specifying where and/or how to display content with the flexible display; and

Fig. 4 is a flow chart illustrating a method.

In the following, identical reference signs refer to identical or at least functionally equivalent features.

DETAILED DESCRIPTION

In the following description, reference is made to the accompanying drawings, which form part of the disclosure, and in which are shown, by way of illustration, specific aspects in which the invention may be placed. It is understood that other aspects may be utilized, and structural or logical changes may be made without departing from the scope of the invention. The following detailed description, therefore, is not to be taken in a limiting sense, as the scope of the invention is defined in the appended claims.

For instance, it is understood that a disclosure in connection with a described method may also hold true for a corresponding device or system configured to perform the method and vice versa. For example, if a specific method step is described, a corresponding device may include a unit to perform the described method step, even if such unit is not explicitly described or illustrated in the figures. On the other hand, for example, if a specific apparatus is described based on functional units, a corresponding method may include a step performing the described functionality, even if such step is not explicitly described or illustrated in the figures. Further, it is understood that the features of the various example aspects described herein may be combined with each other, unless specifically noted otherwise.

At least some embodiments of the present disclosure may automate the expansion and contraction of a flexible display or screen for electronic devices, according to use case scenarios of the

device. For example, at least some embodiments of the present disclosure may automate the expansion and contraction of a flexible display based on user operations in software applications, and/or content being displayed. Furthermore, at least some embodiments of the present disclosure may allow dedicated software features to expand or contract the flexible display, e.g., to allow a user to choose where and/or how to display the content with the flexible screen. Furthermore, at least some embodiments of the present disclosure may provide users notifications when automated display movements take place.

Next, example embodiments of a display device 200 are described based on Fig. 2. Some of the features of the described devices are optional features which may provide further advantages.

Fig. 2 is a block diagram illustrating the display device 200, according to an embodiment of the present disclosure. In an embodiment, the display device 200 may comprise any of various types of devices capable of displaying content to a user on a display or screen. For example, the display device 200 may comprise a portable computer device (e.g., a smartphone, a tablet computer or the like), a television device, a vehicle dashboard screen device, or a wearable computer device (e.g., a smart watch or the like).

The display device 200 comprises a flexible display 206 that is programmably switchable between expansion states including at least two of: a contracted state 100A, one or more partially expanded states 100B, or a fully expanded state 100C. The flexible display 206 may be configured to, e.g., display output images/video and/or prompts to a user, described later in more detail. In an example, the display 206 may comprise a touch screen. For example, the flexible display 206 may comprise a rollable display, a foldable display, or a bendable display. At least in some embodiments, the flexible display 206 may expand to a larger size than the hosting display device 200. For example, the expansion and/or contraction of the flexible display 206 may be motorized. At least in some embodiments, the flexible display 206 may expand horizontally and/or vertically with respect to the orientation of the hosting display device 200.

Fig. 1 includes diagrams illustrating examples of various expansion states of the flexible display 206. The expansion states shown in Fig. 1 include the contracted state 100A, the partially expanded state 100B, and the fully expanded state 100C. At least in some embodiments, the contracted state 100A may correspond to a 0% expanded flexible display 206, and the fully expanded state 100C may correspond to a 100% expanded flexible display 206. At least in some

embodiments, the partially expanded state 100B may correspond to the flexible display 206 when expanded anywhere between 0% and 100%.

The display device 200 may comprise at least one processor or a processing unit 202 and at least one memory 204 coupled to the at least one processor 202, which may be used to implement the functionalities described below in more detail.

The display device 200 may also include other elements, such as a transceiver configured to enable the display device 200 to transmit and/or receive information to/from other devices, and/or input means (such as a physical or virtual keyboard), as well as other elements not shown in Fig. 2. In one example, the display device 200 may use the transceiver to transmit or receive signalling information and data in accordance with at least one cellular communication protocol. The transceiver may be configured to provide at least one wireless radio connection, such as for example a 3GPP mobile broadband connection (e.g., 5G). The transceiver may comprise, or be configured to be coupled to, at least one antenna to transmit and/or receive radio frequency signals.

The at least one processor 202 may include, e.g., one or more of various processing devices, such as a co-processor, a microprocessor, a controller, a digital signal processor (DSP), a processing circuitry with or without an accompanying DSP, or various other processing devices including integrated circuits such as, for example, an application specific integrated circuit (ASIC), a field programmable gate array (FPGA), a microcontroller unit (MCU), a hardware accelerator, a special-purpose computer chip, or the like.

The memory 204 may be configured to store e.g. computer programs and the like. The memory may include one or more volatile memory devices, one or more non-volatile memory devices, and/or a combination of one or more volatile memory devices and non-volatile memory devices. For example, the memory 204 may be embodied as semiconductor memories (such as mask ROM, PROM (programmable ROM), EPROM (erasable PROM), flash ROM, RAM (random access memory), etc.).

The display device 200 is configured to monitor events at the display device 200. For example, the events to be monitored may include user operations in software applications at the display device 200 and/or content displayed on the flexible display 206.

In response to detecting a trigger event among the monitored events, the display device 200 is further configured to determine an expansion state associated with the detected trigger event. For example, the trigger event may comprise performing a predetermined operation in a predetermined software application at the display device 200, displaying predetermined content on the flexible display 206, and/or a predetermined status of the display device 200.

In other words, at least in some embodiments the trigger event may relate to any change or switch to any such content to be displayed on the flexible display 206 that would benefit from being displayed on a larger screen, i.e. in the partially expanded state 100B or the fully expanded state 100C of the flexible display 206.

For example, the trigger event may comprise the user clicking/tapping a full screen icon or the like when viewing a video with a video replay application. In an example of displaying predetermined content, the trigger event may comprise the user starting to watch a high-definition video. In another example, the trigger event may comprise the user selecting on, e.g., a web browser that a new tab is to be shown on an expanded part of a partially or fully expanded flexible display 206.

Further examples of the predetermined operation in the predetermined software application may include the user changing video quality (e.g., between standard definition and high-definition), and the user changing a wireless connection type (e.g., between a mobile network based connection and a wireless local area network (WLAN or Wi-Fi) based connection. Data transfer on a mobile network based connection typically costs more than data transfer on a wireless local area network based connection, and a higher quality video involves more data than a lower quality video. Yet further examples of the predetermined operation in the predetermined software application may include the user switching a multi-window application from a first window to a second window that would benefit from a larger screen.

Further examples of the predetermined content displayed on the flexible display 206 may include a large image, figure, document or the like, and/or an image, figure, document or the like that comprises text. At least in some embodiments, this may make the text more readable and/or make viewing the large image, figure, document or the like more user-friendly.

At least in some embodiments, in the partially expanded state 100B and/or the fully expanded state 100C of the flexible display 206, the content(s) associated with the partially expanded state 100B and/or the fully expanded state 100C may be displayed on a whole screen area of the flexible display 206, or on a part (e.g. the expanded part) of the screen area of the flexible display 206.

In response to the determined expansion state differing from a current expansion state, the display device 200 is further configured to initiate a switch of the flexible display 206 from the current expansion state to the determined expansion state.

At least in some implementations, the display device 200 may be further configured to cause the flexible display 206 to switch from the current expansion state to the determined expansion state in response to the initiation of the switch. In other words, the switch to the determined expansion state may be executed immediately.

Alternatively, at least in some implementations, the display device 200 may be further configured to display a user notification on the flexible display 206 in response to the initiation of the switch. For example, the displayed user notification may request confirmation or cancellation of the switch from the current expansion state to the determined expansion state. In other words, rather than executing the switch to the determined expansion state executed immediately, the user may first be notified and given a chance to confirm or cancel of the switch, optionally before a predetermined time window expires.

At least in some implementations, the display device 200 may be further configured to cause the flexible display 206 to switch from the current expansion state to the determined expansion state in response to obtaining the requested confirmation. At least in some implementations, the display device 200 may be further configured to return to the monitoring of the events at the display device 200 without causing the flexible display 206 to switch from the current expansion state to the determined expansion state in response to obtaining the requested cancellation.

At least in some implementations, the display device 200 may be further configured to return to the monitoring of the events at the display device 200 without causing the flexible display 206 to switch from the current expansion state to the determined expansion state in response to

failing to obtain either of the requested confirmation or cancellation before the predetermined time window expires.

At least in some implementations, the display device 200 may be further configured to obtain configuration information that may indicate, e.g.:

- a degree of expansion of the flexible display 206 in at least one of the one or more partially expanded states 100B,
- at least one software application to be monitored for the trigger events,
- at least one operation of the at least one software application to be monitored for the trigger events,
- displayable content to be monitored for the trigger events,
- at least one status of the display device 200 to be monitored for the trigger events,
- at least one display location on the flexible display 206 in at least one of the expansion states 100A, 100B, 100C, and/or
- at least one display mode on the flexible display 206 in at least one of the expansion states 100A, 100B, 100C.

At least in some implementations, the configuration information may be modifiable or updatable by a user, for example. At least in some implementations, the configuration information may be stored and/or modified/updated from more than one location.

For example, a configuration panel or the like may be provided which users may use to configure settings like the amount of expansion or contraction, the software application(s) to be monitored for the trigger events, the software operation(s) to be monitored for the trigger events, displayable content(s) and/or display device 200 status(es) to be monitored for the trigger events which may trigger the expansion or contraction of the flexible display 206. Additionally/alternatively, users may be provided one or more default settings of the configurations in the configuration panel.

Figs. 3A and 3B illustrate examples of displaying content 208 on the flexible display 206 in various expansion states.

In a first use case example, the automatic expansion or contraction of the flexible display 206 may be executed when the user is viewing videos 208 with a video replay application and

clicks/taps a full screen mode, thereby triggering an automatic expansion from the contracted state 100A as shown in Fig. 3A to the partially expanded state 100B or the fully expanded state 100C as shown in Fig. 3B.

In a second use case example, the automatic expansion or contraction of the flexible display 206 may be executed when the user starts to watch a high-definition video, thereby triggering an automatic expansion from the contracted state 100A as shown in Fig. 3A to the partially expanded state 100B or the fully expanded state 100C as shown in Fig. 3B.

Fig. 3C illustrate an example of a user interface 310 for specifying where and/or how to display content with the flexible display 206.

In a third use case example, the automatic expansion or contraction of the flexible display 206 may be executed when user selects on a web browser 300 (or any suitable software application) via the user interface 310 that a new tab is to be shown on the flexible display 206.

Fig. 4 is a flow chart illustrating a display method 400 for the display device 200, according to an embodiment of the present disclosure. As discussed above in more detail, the display device 200 comprises the flexible display 206 that is programmably switchable between expansion states including at least two of: the contracted state 100A, the one or more partially expanded states 100B, or the fully expanded state 100C.

At optional operation 401, the display device 200 may obtain the configuration information. The configuration information is discussed above in more detail.

At operation 402, the display device 200 monitors events at the display device 200.

In response to detecting at operation 403 a trigger event among the monitored events, the display device 200 determines at operation 404 an expansion state associated with the detected trigger event.

When the determined expansion state differs from a current expansion state at operation 405, the display method 400 proceeds to operation 406 in which the display device 200 initiates a switch of the flexible display 206 from the current expansion state to the determined expansion

state. When the determined expansion state does not differ from the current expansion state at operation 405, the display method 400 may, e.g., return to operation 402 to continue monitoring the events.

From operation 406, the display method 400 may proceed to operation 407 in which the display device 200 may cause the flexible display 206 to switch from the current expansion state to the determined expansion state in response to the initiation of the switch.

Alternatively, from operation 406, the display method 400 may proceed to operation 408 in which the display device 200 may display a user notification on the flexible display 206 in response to the initiation of the switch. The displayed user notification may request confirmation or cancellation of the switch from the current expansion state to the determined expansion state.

Accordingly, from operation 408, the display method 400 may proceed to operation 409, operation 410 or operation 411. At operation 409, the requested confirmation is obtained and the display method 400 may proceed to operation 407 to execute the switch from the current expansion state to the determined expansion state. At operation 410, the requested cancellation is obtained and the display method 400 may, e.g., return to operation 402 to continue monitoring the events. At operation 411, the time window expires before either of the requested confirmation or cancellation is obtained and the display method 400 may, e.g., return to operation 402 to continue monitoring the events.

The method 400 may be performed by the display device 200. The operations 401-411 can, for example, be performed by the at least one processor 202 and the memory 204. Further features of the method 400 directly result from the functionalities and parameters of the display device 200 and thus are not repeated here. The method 400 can be performed by computer program(s).

The display device 200 may comprise means for performing at least one method described herein. In one example, the means may comprise the at least one processor 202, and the at least one memory 204 including program code configured to, when executed by the at least one processor, cause the display device 200 to perform the method.

The functionality described herein can be performed, at least in part, by one or more computer program product components such as software components. According to an embodiment, the display device 200 may comprise a processor or processor circuitry, such as for example a microcontroller, configured by the program code when executed to execute the embodiments of the operations and functionality described. Alternatively, or in addition, the functionality described herein can be performed, at least in part, by one or more hardware logic components. For example, and without limitation, illustrative types of hardware logic components that can be used include Field-programmable Gate Arrays (FPGAs), Program-specific Integrated Circuits (ASICs), Program-specific Standard Products (ASSPs), System-on-a-chip systems (SOCs), Complex Programmable Logic Devices (CPLDs), and Graphics Processing Units (GPUs).

Any range or device value given herein may be extended or altered without losing the effect sought. Also, any embodiment may be combined with another embodiment unless explicitly disallowed.

Although the subject matter has been described in language specific to structural features and/or acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as examples of implementing the claims and other equivalent features and acts are intended to be within the scope of the claims.

It will be understood that the benefits and advantages described above may relate to one embodiment or may relate to several embodiments. The embodiments are not limited to those that solve any or all of the stated problems or those that have any or all of the stated benefits and advantages. It will further be understood that reference to 'an' item may refer to one or more of those items.

The steps of the methods described herein may be carried out in any suitable order, or simultaneously where appropriate. Additionally, individual blocks may be deleted from any of the methods without departing from the spirit and scope of the subject matter described herein. Aspects of any of the embodiments described above may be combined with aspects of any of the other embodiments described to form further embodiments without losing the effect sought.

The term 'comprising' is used herein to mean including the method, blocks or elements identified, but that such blocks or elements do not comprise an exclusive list and a method or apparatus may contain additional blocks or elements.

It will be understood that the above description is given by way of example only and that various modifications may be made by those skilled in the art. The above specification, examples and data provide a complete description of the structure and use of exemplary embodiments. Although various embodiments have been described above with a certain degree of particularity, or with reference to one or more individual embodiments, those skilled in the art could make numerous alterations to the disclosed embodiments without departing from the spirit or scope of this specification.

CLAIMS:

1. A display device (200) comprising a flexible display (206) programmably switchable between expansion states including at least two of a contracted state (100A), one or more partially expanded states (100B), or a fully expanded state (100C), the display device (200) configured to:

monitor events at the display device (200);

in response to detecting a trigger event among the monitored events, determine an expansion state associated with the detected trigger event; and

in response to the determined expansion state differing from a current expansion state, initiate a switch of the flexible display (206) from the current expansion state to the determined expansion state.

2. The display device (200) according to claim 1, further configured to cause the flexible display (206) to switch from the current expansion state to the determined expansion state in response to the initiation of the switch.

3. The display device (200) according to claim 1, further configured to display a user notification on the flexible display (206) in response to the initiation of the switch, the displayed user notification requesting confirmation or cancellation of the switch from the current expansion state to the determined expansion state.

4. The display device (200) according to claim 3, further configured to cause the flexible display (206) to switch from the current expansion state to the determined expansion state in response to obtaining the requested confirmation.

5. The display device (200) according to claim 3, further configured to return to the monitoring of the events at the display device (200) without causing the flexible display (206) to switch from the current expansion state to the determined expansion state in response to obtaining the requested cancellation.

6. The display device (200) according to claim 3, further configured to return to the monitoring of the events at the display device (200) without causing the flexible display (206) to switch from the current expansion state to the determined expansion state in response

to failing to obtain either of the requested confirmation or cancellation before a predetermined time window expires.

7. The display device (200) according to any of claims 1 to 6, wherein the trigger event comprises at least one of performing a predetermined operation in a predetermined software application at the display device (200), displaying predetermined content on the flexible display (206), or a predetermined status of the display device (200).

8. The display device (200) according to any of claims 1 to 7, further configured to obtain configuration information indicating at least one of: a degree of expansion of the flexible display (206) in at least one of the one or more partially expanded states (100B), at least one software application to be monitored for the trigger events, at least one operation of the at least one software application to be monitored for the trigger events, displayable content to be monitored for the trigger events, at least one status of the display device (200) to be monitored for the trigger events, at least one display location on the flexible display (206) in at least one of the expansion states (100A, 100B, 100C), or at least one display mode on the flexible display (206) in at least one of the expansion states (100A, 100B, 100C).

9. The display device (200) according to any of claims 1 to 8, wherein the flexible display (206) comprises a rollable display, a foldable display, or a bendable display.

10. The display device (200) according to any of claims 1 to 9, wherein the display device (200) comprises a portable computer device, a television device, a vehicle dashboard screen device, or a wearable computer device.

11. A display method (400) for a display device (200) comprising a flexible display (206) programmably switchable between expansion states including at least two of a contracted state (100A), one or more partially expanded states (100B), or a fully expanded state (100C), the display method (400) comprising:

monitoring (402), by the display device (200), events at the display device (200);

in response to detecting (403), by the display device (200), a trigger event among the monitored events, determining (404), by the display device (200), an expansion state associated with the detected trigger event; and

in response to the determined expansion state differing (405) from a current expansion state, initiating (406), by the display device (200), a switch of the flexible display (206) from the current expansion state to the determined expansion state.

12. The display method (400) according to claim 11, further comprising causing (407), by the display device (200), the flexible display (206) to switch from the current expansion state to the determined expansion state in response to the initiation of the switch.

13. The display method (400) according to claim 11, further comprising displaying (408), by the display device (200), a user notification on the flexible display (206) in response to the initiation of the switch, the displayed user notification requesting confirmation or cancellation of the switch from the current expansion state to the determined expansion state.

14. The display method (4040) according to claim 13, further comprising:

a) causing (407), by the display device (200), the flexible display (206) to switch from the current expansion state to the determined expansion state in response to obtaining (409) the requested confirmation;

b) returning, by the display device (200), to the monitoring (402) of the events at the display device (200) without causing the flexible display (206) to switch from the current expansion state to the determined expansion state in response to obtaining (410) the requested cancellation; and

c) returning, by the display device (200), to the monitoring (402) of the events at the display device (200) without causing the flexible display (206) to switch from the current expansion state to the determined expansion state in response to failing (411) to obtain either of the requested confirmation or cancellation before a predetermined time window expires.

15. A computer program product comprising program code configured to perform a display method (400) according to any of claims 11 to 14, when the program code is executed on a display device.

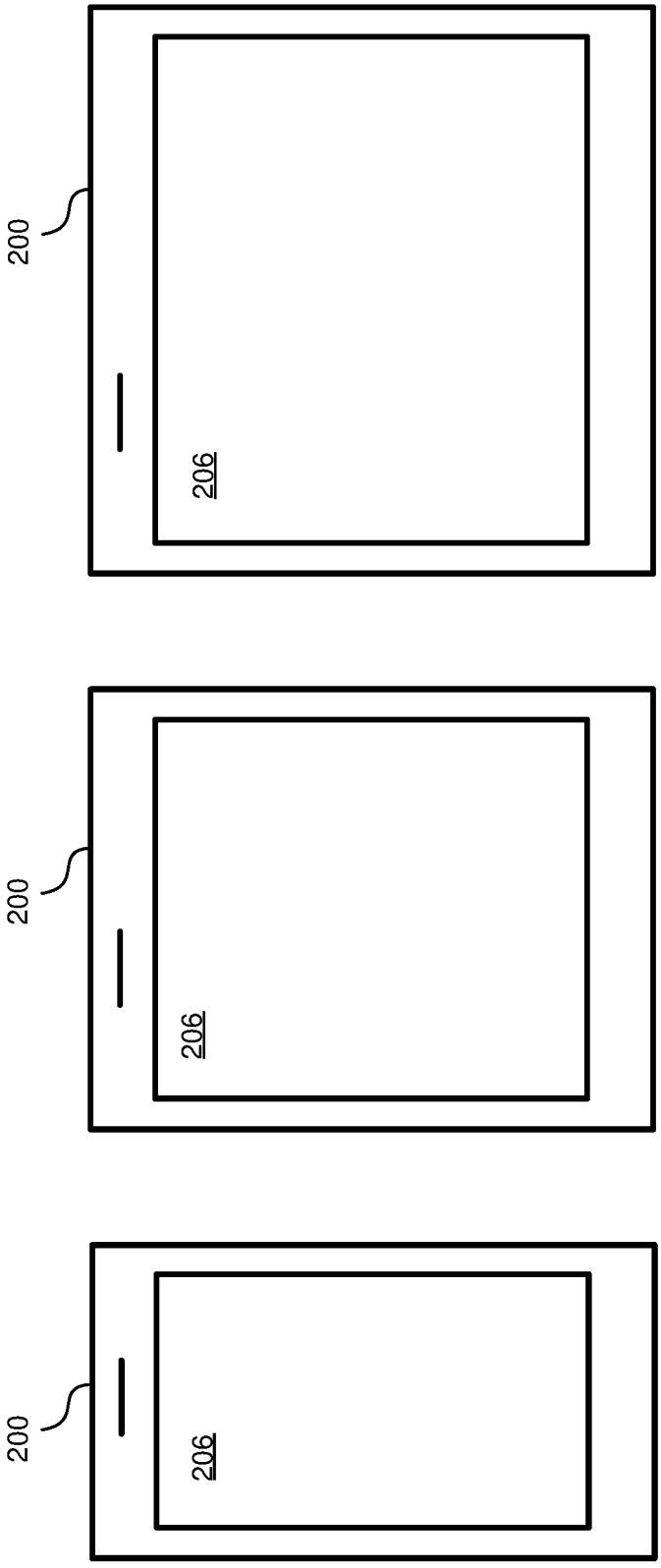

FIG. 1

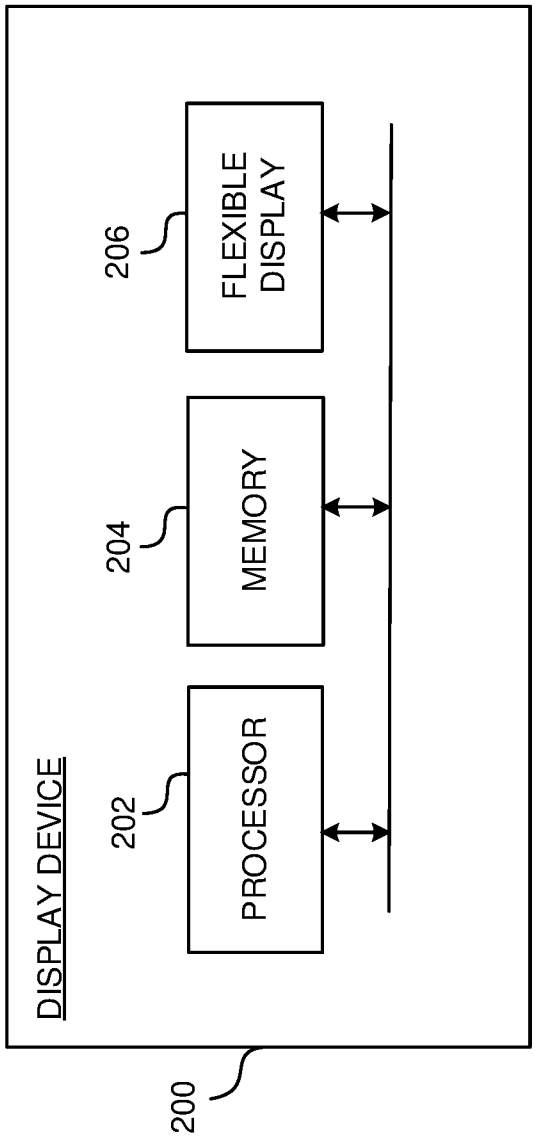
DISPLAY DEVICE
200
PROCESSOR
202
MEMORY
204
FLEXIBLE DISPLAY
206

FIG. 2

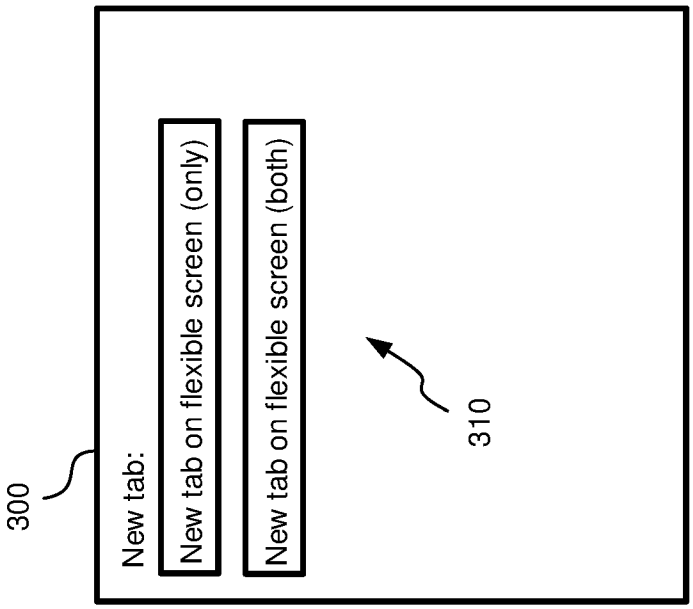

FIG. 3C

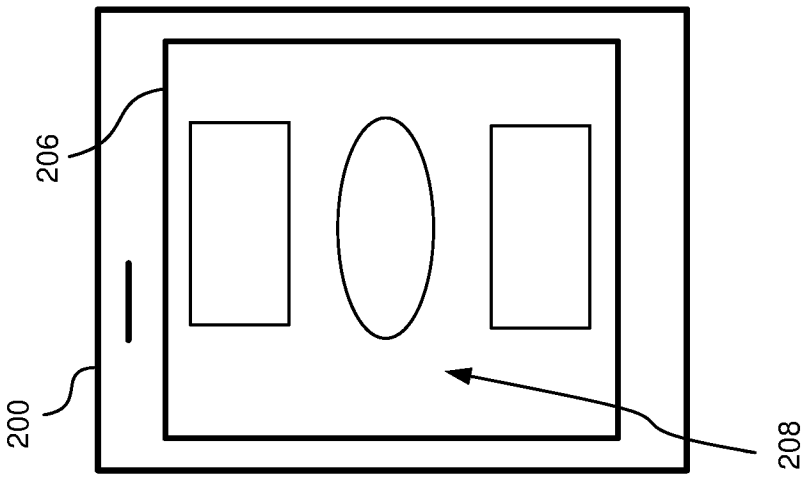

FIG. 3B

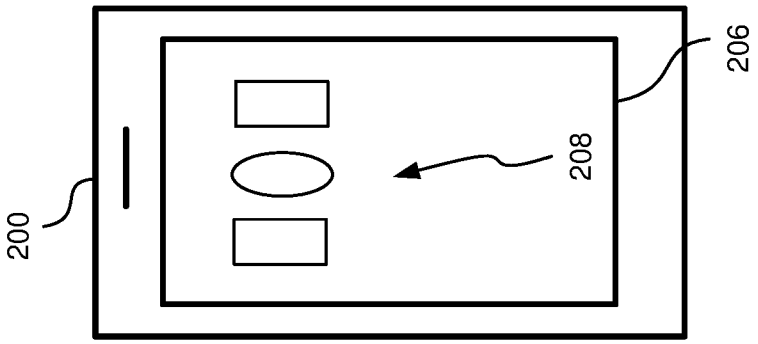

FIG. 3A

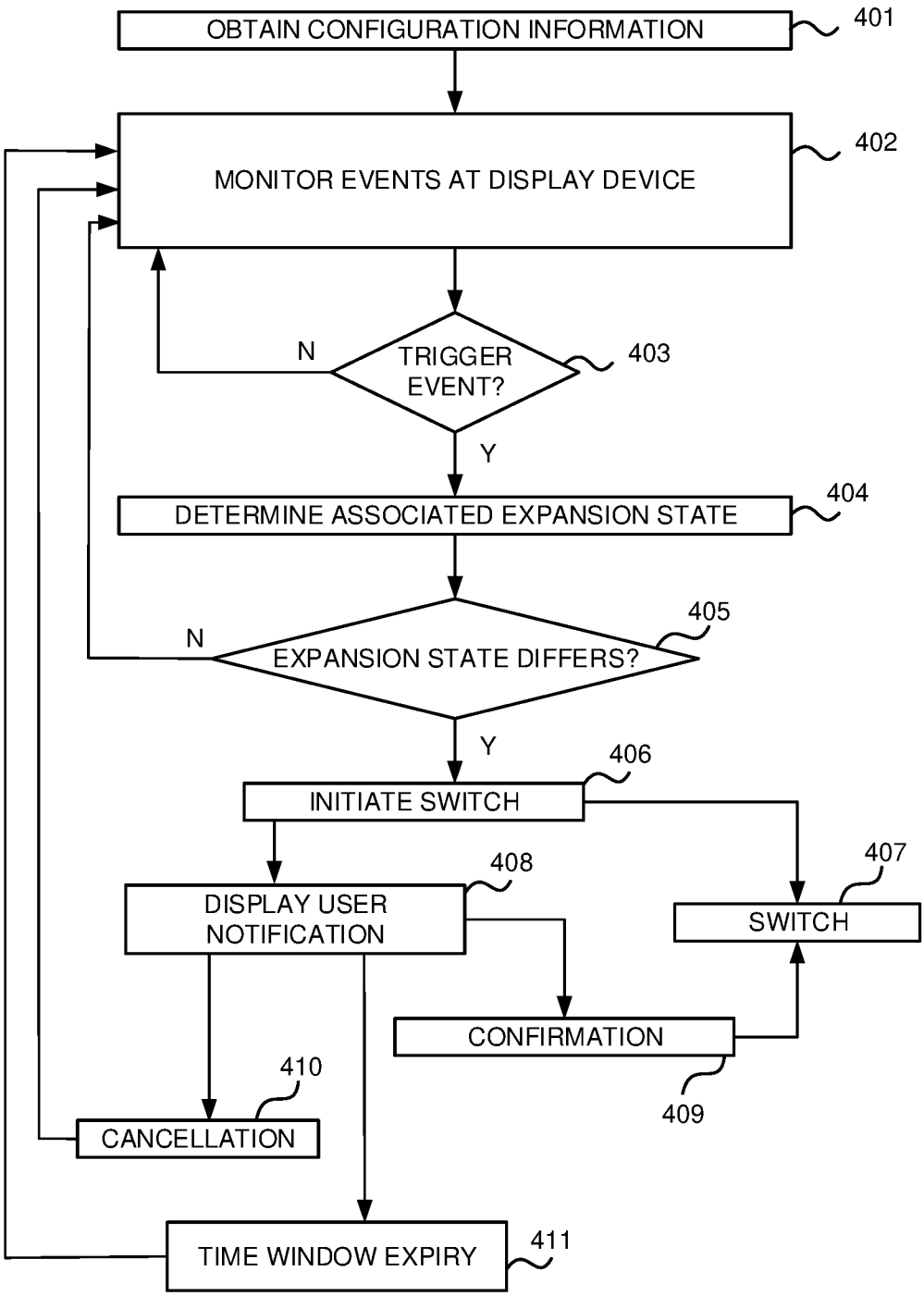
OBTAIN CONFIGURATION INFORMATION
401
MONITOR EVENTS AT DISPLAY DEVICE
402
TRIGGER EVENT?
403
N
Y
DETERMINE ASSOCIATED EXPANSION STATE
404
EXPANSION STATE DIFFERS?
405
N
Y
INITIATE SWITCH
406
DISPLAY USER NOTIFICATION
408
SWITCH
407
CONFIRMATION
409
CANCELLATION
410
TIME WINDOW EXPIRY
411
400

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2022/081762

A. CLASSIFICATION OF SUBJECT MATTER
INV. G09G3/00 G06F1/16
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G09G G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2009/051830 A1 (MATSUSHITA YOSHITERU [JP] ET AL) 26 February 2009 (2009-02-26) paragraph [0023] paragraph [0156] - paragraph [0250]	1-15
X	KR 2022 0079189 A (SAMSUNG ELECTRONICS CO LTD [KR]) 13 June 2022 (2022-06-13) abstract; figures 5(a)-11(c)	1-15

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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"Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 May 2023	30/05/2023

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Njibamum, David

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2022/081762

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US 2009051830 A1	26-02-2009	CN 101171621 A	30-04-2008
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		WO 2007077649 A1	12-07-2007
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